

1. An applicator for dispensing a coating material onto a substrate, the applicator comprising:
  - a body comprising
    - a distal end,
    - 5 a liquid flow passage having a liquid inlet adapted to receive the coating material, and
    - a fluid passage having a fluid inlet adapted to receive a pressurized fluid;
    - a needle extending through the liquid flow passage;
    - 10 a needle guide disposed near the distal end of the body and having inner surfaces that receive, align and laterally support the needle;
    - a nozzle disposed at the distal end of the body, the nozzle comprising a bore receiving the needle and a distal end extending beyond other structure of the applicator;
    - 15 a seat disposed at the distal end of the nozzle;
    - a dispensing orifice extending through the seat, one end of the needle being movable into contact with the seat and through the dispensing orifice to terminate a flow of the coating material through the dispensing orifice and eliminate any coating material flow path downstream of the seat;
    - 20 a cap disposed around the nozzle comprising a proximal end removably mounted to the body, and a distal end; and
    - a fluid path formed between the nozzle and the cap and contiguous with the fluid passage, the fluid path having a fluid outlet at the distal end of the cap.

2. The applicator of claim 1 wherein the fluid outlet is an annular opening between the distal end of the cap and the nozzle.

3. The applicator of claim 1 wherein the distal end of the nozzle has a  
5 taper, and the distal end of the cap is tapered to conform with the taper of the distal end of the nozzle.

4. The applicator of claim 1 wherein the body further comprises:  
an extension comprising an internal passage contiguous with the liquid  
10 flow passage and receiving the needle therethrough, the cap being disposed around the extension and the fluid path being formed between cap and the extension, the needle guide being disposed in a bore in a distal end of the extension, and the nozzle being mounted on the distal end of the extension.

15 5. The applicator of claim 1 wherein the needle remains disposed through the dispensing orifice when the needle is moved out of contact with the seat to permit the flow of coating material through the dispensing orifice.

6. The applicator of claim 1 wherein the needle guide comprises axially  
20 extending liquid paths between the inner surfaces and contiguous with the internal passage to conduct the coating material between the internal channels and the needle.

7. An applicator for dispensing a coating material onto a substrate, the applicator comprising:

a body comprising

a distal end,

5 a liquid flow passage having a liquid inlet adapted to receive the coating material, and

a fluid passage having a fluid inlet adapted to receive a pressurized fluid;

a needle extending through the liquid flow passage;

10 an extension comprising a longitudinal throughbore contiguous with the liquid flow passage and receiving the needle therethrough;

a needle guide disposed in the throughbore near a distal end of the extension and having inner surfaces that receive, align and laterally support the needle;

15 a nozzle disposed at the distal end of the extension, the nozzle comprising a bore receiving the needle and having a taper at a distal end extending beyond other structure of the applicator;

a seat disposed at the distal end of the nozzle;

20 a dispensing orifice extending through the seat, one end of the needle being movable into contact with the seat and through the dispensing orifice to terminate a flow of the coating material through the dispensing orifice and eliminate any coating material flow path downstream of the seat; and

a tubular cap disposed around the extension and the nozzle comprising

a proximal end removably mounted to the body, and a distal end tapered to

conform to the taper of the distal end of the nozzle, the cap forming with the extension and the nozzle a fluid path contiguous with the fluid passage, the fluid path having a fluid outlet at the distal end of the cap.

8. An apparatus for dispensing a coating material onto a substrate, the apparatus comprising:

an applicator comprising

a body comprising

5 a liquid flow passage having a liquid inlet adapted to receive the coating material,

a fluid passage comprising a fluid inlet adapted to receive a pressurized fluid, and a fluid outlet discharging the pressurized fluid at a distal end of the body,

10 a nozzle mounted in the distal end of the body, the nozzle having an exposed nozzle end extending further downstream than any other portion of the applicator,

a dispensing valve disposed in the nozzle,

a valve actuator connected to the dispensing valve and operable to open and

15 close the dispensing valve;

a positioner supporting the applicator and operable to move the applicator with respect to the substrate;

a wiper actuator mounted on the positioner and movable with the applicator;

20 a wiper connected to the wiper actuator, the wiper being movable by the wiper actuator into contact with the exposed nozzle end; and

a programmable control connected to the valve actuator, the wiper actuator and the positioner, the programmable control being operable under

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program control to cause the wiper actuator to move the wiper into contact with the exposed nozzle end.

9. An apparatus for dispensing a coating material onto a substrate, the apparatus comprising:
- a pressurized liquid supply providing a coating material;
  - a pressurized fluid supply providing a fluid;
- 5 a first regulator fluidly connected to the pressurized liquid supply and providing a plurality of selectable liquid pressures for dispensing the coating material;
- a second regulator fluidly connected to the pressurized fluid supply and providing a plurality of fluid pressures usable in association with dispensing
- 10 the coating material and a high fluid pressure greater than a pressure used for dispensing the coating material;
- an applicator comprising
    - a body comprising
      - a liquid flow passage having a liquid inlet receiving the
- 15 coating material,
- a fluid passage comprising a fluid inlet fluidly receiving the fluid at a fluid pressure, and a fluid outlet discharging the fluid against the coating material;
- a nozzle mounted in the distal end of the body, the nozzle
- 20 having a dispensing orifice at a nozzle distal end, the nozzle distal end extending downstream further than any other portion of the applicator;
- a dispensing valve disposed in the nozzle and operable to dispense coating material through the dispensing orifice,

an actuator connected to the dispensing valve and operable to open and close the dispensing valve,

a positioner supporting the applicator and operable to move the applicator with respect to the substrate; and

5 a programmable control connected to the first regulator, the second regulator, the actuator and the positioner, the programmable control being operable to under program control select different dispensing patterns of coating material, each dispensing pattern of coating material being created by the programmable control selecting a combination of one of the plurality of  
10 selectable liquid pressures and one of the plurality of selectable fluid pressures, the programmable control being further operable to under program control to select the high fluid pressure to blow off the nozzle distal end.

10. The apparatus of claim 9 further comprising a catcher cup, the  
15 programmable control being operable under program control to move the nozzle distal end over the catcher cup prior to selecting the high fluid pressure, so that material on the nozzle distal end is blown off into the catcher cup.

20 11. The apparatus of claim 10 wherein the coating material is a solid conformal coating material comprises a 100 % solids coating formulation.



12. The apparatus of claim 9 wherein the dispensing valve further comprises

a needle extending through the liquid flow passage;

5 a seat disposed at the distal end of the nozzle, one end of the needle being movable into contact with the seat and through the dispensing orifice to terminate a flow of the coating material through the dispensing orifice and eliminate any coating material flow path downstream of the seat.

13. The apparatus of claim 12 further comprising a needle guide disposed  
10 near the distal end of the body upstream of the nozzle and having an inner surfaces that align and laterally support the needle.

14. An applicator for dispensing a coating material onto a substrate, the applicator comprising:

a body comprising

a distal end,

5 a liquid flow passage having a liquid inlet adapted to receive the coating material, and

a fluid passage having a fluid inlet adapted to receive a pressurized fluid;

a needle extending through the liquid flow passage;

10 an extension comprising

a proximal end removably mounted to the body,

an internal passage contiguous with the liquid flow passage and receiving the needle, and

a distal end,

15 a nozzle disposed at the distal end of the extension, the nozzle comprising a bore receiving the needle and a distal;

a seat disposed in the distal end of the nozzle;

a dispensing orifice extending through the seat, the needle being movable into contact with, and away from, the seat;

20 a tubular cap disposed around the extension and the nozzle comprising

a proximal end removably mounted to the body,

a distal end,

the cap forming a fluid path with the extension and the nozzle, the fluid path being contiguous with the fluid passage;

an upper alignment guide disposed in the fluid path near the proximal ends of the extension and the cap, the upper alignment guide coaxially aligning the proximal ends of the extension and the cap; and

5 a lower alignment guide disposed in the fluid path near the distal ends of the extension and the cap, the lower alignment guide coaxially aligning the distal ends of the extension and the cap.

15. The applicator of Claim 14 wherein the fluid path between the extension and the cap is annular and unobstructed between the upper  
10 alignment guide and the lower alignment guide.

16. The applicator of claim 15 wherein the upper alignment guide comprises upper splines extending from one of the extension and the cap, and the lower alignment guide comprises lower splines extending from one of  
15 the extension and the cap.

17. The applicator of claim 16 wherein the upper splines extend inward from an inner surface of the cap.

20 18. The applicator of claim 16 wherein the lower splines extend outward from an outer surface of the extension.

19. The applicator of claim 18 further comprising:

upper spaces extending between the upper splines, the upper spaces  
conducting the pressurized fluid; and

lower spaces extending between the lower splines, the lower spaces  
5 conducting the pressurized fluid.

20. The applicator of claim 19 wherein the lower spaces comprise  
respective lengths substantially parallel to a longitudinal centerline of the  
extension.

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21. The applicator of claim 19 wherein the lower spaces comprise  
respective lengths oblique to a longitudinal centerline of the extension.

22. The applicator of claim 14 further comprising a needle guide removably  
15 mounted in the liquid flow passage near the distal end of the extension and  
having inner surfaces laterally supporting the needle in a coaxial relationship  
with the extension.

23. An applicator for dispensing a coating material onto a substrate, the applicator comprising:
- a body comprising
    - a distal end,
    - 5 a liquid flow passage having a liquid inlet adapted to receive the coating material, and
    - a fluid passage having a fluid inlet adapted to receive a pressurized fluid;
    - a needle extending through the liquid flow passage;
    - 10 an extension comprising
      - a proximal end removably mounted to the body,
      - an internal passage contiguous with the liquid flow passage and receiving the needle,
      - a distal end, and
      - 15 lower splines extending outward from an outer surface of the extension at its distal end;
    - a nozzle disposed at the distal end of the extension, the nozzle comprising a bore receiving the needle and a distal;
    - a seat disposed in the distal end of the nozzle;
    - 20 a dispensing orifice extending through the seat, the needle being movable into contact with, and away from, the seat; and
    - a tubular cap disposed around the extension and the nozzle comprising
      - a proximal end removably mounted to the body,

upper splines extending inward from an inner surface at the proximal end of the cap, the upper splines coaxially aligning the respective proximal ends of the extension and the cap,

a distal end, the distal end of the cap being coaxially aligned  
5 with the distal end of the extension by the lower splines,

the cap forming a fluid path with the extension and the nozzle,  
the fluid path being contiguous with the fluid passage.

24. An applicator for dispensing a coating material onto a substrate, the applicator having a body with a liquid flow passage for receiving the coating material and a fluid passage for receiving a pressurized fluid, a dispensing valve disposed in a distal end of the body, and a cap disposed around the  
5 body and forming a fluid path conducting the pressurized fluid, the applicator comprising:

a nozzle comprising

a proximal end adapted to be mounted to a distal end of the body and received within the air cap,

10 a centerbore adapted to receive the dispensing valve,

a distal end,

a dispensing orifice extending through the distal end, and

a tapered downstream end having an outer surface polished smooth and coated with material that inhibits an accumulation and adhesion  
15 of the coating material.

25. The applicator of claim 24 wherein the applicator has a needle with a tapered distal end and the centerbore of the nozzle comprises a downstream end with a taper generally conforming to the tapered distal end of the needle  
20 so that the tapered distal end of the needle is extendable through the dispensing orifice.

26. An applicator for dispensing a coating material onto a substrate, the applicator having a liquid flow passage for receiving the coating material and a fluid passage for receiving a pressurized fluid, a nozzle is mounted at a distal end of the body, and a dispensing valve is disposed in the nozzle, the  
5 air cap comprising:  
a tubular body disposed around the nozzle and comprising  
a proximal end removably mounted to the body,  
an alignment guide disposed at the proximal end of the cap for coaxially aligning the cap with the body, the cap forming a fluid path with the  
10 nozzle contiguous with the fluid passage, and  
a distal end forming a fluid outlet with nozzle.
27. The applicator of claim 26 wherein the alignment guide comprises a plurality of radially directed splines extending from an inner surface of the cap,  
15 the splines being separated by spaces adapted to conduct the pressurized fluid between the splines.
28. The applicator of claim 26 wherein the fluid outlet is a circular opening at the distal end of the cap.  
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29. The applicator of claim 26 wherein the distal end of the nozzle comprises a taper and the distal end of the cap is tapered to conform to the taper on the nozzle.



30. The applicator of claim 26 wherein the proximal end of the cap comprises a flange for mounting the cap to the body.

31. An applicator for dispensing a coating material onto a substrate, the applicator having a body with a liquid flow passage for receiving the coating material and a fluid passage for receiving a pressurized fluid, a nozzle having a dispensing valve disposed therein, and a cap disposed around the nozzle  
5 and forming a fluid path conducting the pressurized fluid, the applicator further comprising:

a tubular extension comprising

a proximal end adapted to be removably mounted to the body,

a distal end,

10 an alignment guide disposed at the distal end of the extension and adapted to coaxially align the extension with the cap, the extension having an inner bore adapted to be contiguous with the liquid flow passage and conduct the coating material through the extension.

15 32. The applicator of Claim 31 wherein the extension comprises a plurality of splines extending from an outer surface of the extension, the splines being separated by spaces adapted to conduct the pressurized fluid between the splines.

20 33. The applicator of claim 32 wherein the splines comprise respective lengths extending substantially parallel to a centerline of the extension.

34. The applicator of claim 32 wherein the splines comprise respective lengths extending oblique to a centerline of the extension.

35. The applicator of claim 32 wherein the proximal end of the extension comprises external threads for mounting the extension to the body.

5 36. The applicator of claim 35 wherein the distal end of the extension comprises internal threads for mounting the nozzle to the extension.

37. The applicator of claim 36 wherein the external threads have a pitch substantially equal to a pitch of the internal threads.

38. An apparatus for dispensing a coating material onto a substrate, the apparatus comprising:

a body comprising

a liquid flow passage having a liquid inlet adapted to receive the coating  
5 material,

a fluid passage comprising a fluid inlet adapted to receive a pressurized fluid,  
and

a fluid outlet discharging the pressurized fluid at a distal end of the body;

a nozzle mounted in the distal end of the body, the nozzle having a  
10 tapered distal end;

a dispensing valve disposed in the nozzle; and

a cap disposed around the nozzle comprising

a proximal end removably mounted to the body,

a distal end tapered to conform with the tapered distal end of the nozzle, and

15 the cap and nozzle forming a fluid path therebetween contiguous with the  
fluid passage.

39. The apparatus of claim 38 further comprising a fluid outlet formed  
20 between the distal end of the cap and the nozzle.

40. The apparatus of claim 38 wherein the tapered distal end of the nozzle  
extends further downstream than any other portion of the applicator.

41. A method of automatically dispensing a coating material onto a substrate with an applicator being movable by a programmable control operating a positioner supporting the applicator, the applicator having a dispensing nozzle, a liquid flow passage conducting a coating material to the dispensing nozzle, a fluid passage with a fluid outlet discharging pressurized fluid toward coating material exiting the dispensing nozzle, a dispensing valve operable by the control to dispense the coating material through the dispensing nozzle and onto a substrate, the method comprising:

moving the applicator with the positioner under program control to a location adjacent a receptacle for catching coating material being projected from the nozzle tip; and

initiating with the control a flow of high pressure fluid through the fluid outlet at a pressure higher than a pressure normally used to dispense the coating material; and

blowing with the high pressure fluid the coating material off of the dispensing nozzle and into the receptacle.

42. The method of claim 41 further comprising prior to moving the applicator under program control to the receptacle:

moving the applicator with the positioner under program control to a location adjacent a container of solvent for the coating material; and

then, moving the applicator with the positioner under program control to a location dipping the nozzle tip into the container of solvent for a period of time.

- 5 43. The method of claim 41 wherein the high pressure fluid is initiated at a pressure in a range of about 5-90 psi.

44. A method of automatically dispensing a coating material onto a substrate with an applicator being movable by a programmable control operating a positioner supporting the applicator, the applicator having a dispensing nozzle, a liquid flow passage conducting a coating material to the dispensing nozzle, a fluid passage with a fluid outlet discharging pressurized fluid toward coating material exiting the dispensing nozzle, a dispensing valve operable by the control to dispense the coating material through the dispensing nozzle and onto a substrate, the method comprising:

initiating operation of a wiper actuator mounted on the positioner to cause a wiper connected to the wiper actuator to be moved into contact with, or close to, the nozzle.

45. The method of claim 44 further comprising:

initiating with the control a flow of high pressure fluid through the fluid outlet at a pressure higher than a pressure normally used to dispense the coating material; and

blowing with the high pressure fluid the coating material off of the dispensing nozzle and onto the wiper.

46. The method of claim 45 further comprising initiating operation of a wiper actuator to cause the wiper to be moved away from the nozzle.

47. A method of dispensing a coating material onto a substrate using an applicator having a body with a liquid flow passage for receiving the coating material and a fluid passage for receiving a pressurized fluid, a nozzle having a dispensing valve operable by a control to dispense the coating material  
5 through a dispensing orifice onto a substrate, and a cap disposed around the nozzle and forming a fluid path conducting the pressurized fluid, the method comprising:
- opening the dispensing valve to initiate a flow of a stream of coating material from the applicator;
- 10 initiating a flow of pressurized fluid through the fluid passage and through spaces between splines in the fluid passage immediately upstream of the nozzle, the spaces having respective lengths extending substantially parallel to a longitudinal centerline of the nozzle; and
- discharging the pressurized fluid against the stream of coating material  
15 to form a randomized monofilament pattern of coating material on the substrate.
48. The method of Claim 47 further comprising discharging the pressurized fluid through an annular fluid outlet formed between a distal end of the cap  
20 and the nozzle upstream of the dispensing orifice



49. A method of dispensing a coating material onto a substrate using an applicator having a body with a liquid flow passage for receiving the coating material and a fluid passage for receiving a pressurized fluid, a nozzle mounted on an end of an extension connected to the body, the nozzle having  
5 a dispensing valve operable by a control to dispense the coating material through a dispensing orifice onto a substrate, and a cap disposed around the extension and the nozzle and forming a fluid path conducting the pressurized fluid, the method comprising:

opening the dispensing valve to initiate a flow of a stream of coating  
10 material through the body, the extension, the nozzle and the dispensing orifice;

initiating a flow of pressurized fluid through the fluid passage and through spaces between splines in the fluid passage immediately upstream of the nozzle, the spaces having respective lengths extending oblique to a  
15 longitudinal centerline of the nozzle; and

discharging the pressurized fluid through an annular fluid outlet formed between a distal end of the cap and the nozzle upstream of the dispensing orifice, the pressurized fluid being discharged against the stream of coating material to form a rotational monofilament pattern of coating material on the  
20 substrate.